REPAIRING AND UNDERPINNING BRIDGE ABUTMENTS, PIERS, AND RETAINING WALLS

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In preparing papers on various subjects the authors usually write from their own experiences. Therefore, it is well to know something about the speaker's geographical location, since this often determines the problems to be considered and how their solutions may be applied to other conditions.

Those of you who have ever noticed the relief map in the Civil Engineering Building have noted that the highest altitude in Indiana is in the northern part of Wayne County and the southern part of Randolph County. Naturally, these points represent the peak of the watershed where numerous streams find their source. Hence, we have no large streams to contend with, as do many of you who live in other localities. The experiences, therefore, that I have had in reinforcing abutments are on smaller structures. The longest bridge we have is only about two hundred feet. The average is much less.

There are various reasons for abutment failures. First, a very common cause of failure is a shifting of the channel of the stream so that it strikes directly at one of the abutments. This condition may occur through the formation of sand or gravel bars upstream from or underneath the bridge. The remedy involves straightening and clearing of the channel, both above and below the structure, and underpinning the abutment. This work requires the use of a power-shovel or a drag-line. Those of you who are fortunate enough to own such equipment undoubtedly have found it quite valuable in saving some of your endangered structures.

A second cause of needed repairs to abutments comes from the removal of dams in larger streams or the dredging of streams; either change materially lowers the bottom of the stream below what was anticipated when the structure was erected and causes the undermining of the abutments. I had this experience after the 1937 flood destroyed a dam on one of our streams. This so altered the stream bed that when the water subsided I found an abutment with fully six feet of the supporting piling exposed. The bridge was simply sitting on stilts. I have had similar experiences in smaller structures, when the stream bed was so lowered by dredging operations that the structures were endangered.

A third and very common cause of needed repairs on smaller structures is purely a matter of failure of the concrete. Many of these were constructed years ago, with pit-run gravel, without reinforcing steel, and in most cases hand mixed. Freezing, thawing, and other climatic effects have worn away the foundations of these structures which otherwise may be in fairly good condition.

The repair job needed varies with the extent to which deterioration or damage by water has progressed. It involves excavating around the abutments and wings down to a good foundation, as determined by the soil conditions. The thickness of the reinforcing wall needed will be determined by the depth of the excavation and the height to which you wish to carry the new wall on the present abutment. I usually use a foot of thickness at the top and taper out toward channel, the width of base being determined by the height of the reinforcing wall. *Be sure to get this subwall deep enough in the earth to prevent any future scouring underneath!* If the present abutment is seriously undermined, for safety's sake it is well to do the underpinning in alternate sections.

The construction procedure depends upon the conditions. Often, in the dry season, it can be done without much interference from water. Usually, however, it will require a cofferdam and the use of water pumps to handle the excavating and proper placement of the concrete. In some cases where the soil in the stream bed was easily eroded, I have paved the channel from abutment to abutment with concrete to prevent further scours. This paved strip should have a cut-off wall at both the upper and lower end to insure that the water will not get out underneath. I have found this type of repair work very helpful in gravelly soil.

As is true in a lot of this repair work, money will be saved if it is done in time. If neglected, the abutment will be so undermined that it will settle out of line. This deformation may require cribbing-up under the bridge and the building of a complete new abutment. After the high water of '37 we had three bridges that required this type of work.

Those of you who are fortunate enough to be near a ready-mix concrete plant will save a lot of time and insure good concrete work by using ready-mix concrete.

When available, I would use reinforcing steel in some of this work, particularly on wing-walls of abutments and on floor work. However, I think that, by making walls thick enough, steel can be eliminated without lessening the value of the job.

This job of reinforcing abutments is just one of the many facing a county road supervisor trying to get by with limited funds, and requires only the liberal use of the common sense given to each of us by our Creator.

CLEANING AND PAINTING STEEL BRIDGES

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The cleaning, painting, and repair of steel bridges is a big task for any county highway department. It is an obligation that is sadly neglected by most of us.